PROCESS FOR PRODUCING TAURINE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 14/120,651, filed on Jun. 12, 2014, which is a continuation-in-part of application Ser. No. 14/120,046, filed on Apr. 18, 2014, both of which are incorporated here by reference.

TECHNICAL FIELD

The present invention relates to a process for the production of taurine from alkali isethionate in a high overall yield (i.e., greater than 90% to nearly quantitative) by carrying out the ammonolysis reaction of alkali isethionate to alkali taurinate in the presence of alkali ditaurinate or alkali tritaurinate, or their mixture.

BACKGROUND OF THE INVENTION

Taurine can be referred to as 2-aminoethanesulfonic acid and is one of the amino sulfonic acids found in the tissues of many animals. Taurine is an extremely useful compound with beneficial pharmacological effects, such as detoxification, fatigue-relief, and nourishing and tonifying effects. As a result, taurine finds wide applications as an essential ingredient for human and animal nutrition.

Taurine is currently produced in an amount of over 50,000 tons per year from either ethylene oxide or monoethanolamine. At the present time, most taurine is produced from ethylene oxide, following a three-step process: (1) the addition reaction of ethylene oxide with sodium bisulfite to yield sodium isethionate; (2) the ammonolysis of sodium isethionate to yield sodium taurinate; (3) the neutralization with an acid, i.e., hydrochloric acid and, preferably, sulfuric acid, to generate taurine and inorganic salts.

Although the ethylene oxide process is well established and widely practiced in commercial production, the overall yield is not very high, less than 80%. Moreover, the process generates a large waste stream that is increasingly difficult to dispose of.

The first stage of the ethylene oxide process, the addition reaction of ethylene oxide with sodium bisulfite, is known to yield sodium isethionate in high yield, practically quantitative, as disclosed in U.S. Pat. No. 2,820,818 under described conditions.

Therefore, the problems encountered in the production of taurine from the ethylene oxide process arise from the ammonolysis of sodium isethionate and from the separation of taurine from sodium sulfate.

U.S. Pat. No. 1,932,907 discloses that sodium taurinate is obtained in a yield of 80%, when sodium isethionate undergoes ammonolysis reaction in a molar ratio of 1:6.8 for 2 hrs at 240 to 250° C. U.S. Pat. No. 1,999,614 describes the use of catalysts, i.e., sodium sulfate, sodium sulfite, and sodium carbonate, in the ammonolysis reaction. A mixture of sodium taurinate and sodium ditaurinate is obtained in a yield as high as 97%. However, the percentage for sodium taurinate and sodium ditaurinate in the mixture is not specified.

DD219023 describes detailed results on the product distribution of the ammonolysis reaction of sodium isethionate. When sodium isethionate undergoes the ammonolysis reaction with 25% aqueous ammonia in a molar ratio of 1:9 at about 280° C. for 45 minutes in the presence of sodium

sulfate and sodium hydroxide as catalyst, the reaction products comprise 71% of sodium taurinate and 29% of sodium di- and tri-taurinate.

WO01/77071 is directed to a process for the preparation of ditaurine by heating an aqueous solution of sodium taurinate at a temperature of 210° C. in the presence of a reaction medium. A mixture of sodium taurinate and sodium ditaurinate is obtained.

It is therefore concluded from the foregoing references that the ammonolysis of sodium isethionate invariably yields a mixture of sodium taurinate, sodium ditaurinate, and sodium tritaurinate. The percentage yield of sodium taurinate has not been more than 80%.

In order to obtain taurine from sodium taurinate, U.S. Pat. No. 2,693,488 discloses a method of using ion exchange resins involving a strongly acid ion exchange resin in hydrogen form, and then an anion exchange resin in basic form. This process is complicated and requires the use of a large quantity of acid and base to regenerate the ion exchange resins in each production cycle.

On the other hand, CN101508657, CN101508658, CN101508659, and CN101486669 describe a method of using sulfuric acid to neutralize sodium taurinate to obtain a solution of taurine and sodium sulfate. Crude taurine is easily obtained by filtration from a crystalline suspension of taurine after cooling. However, the waste mother liquor still contains taurine, sodium sulfate, and other unspecified organic impurities, which are identified as a mixture of sodium ditaurinate and sodium tritaurinate.

In the co-pending application Ser. No. 14/120,046, a novel process is disclosed for converting alkali ditaurinate or alkali tritaurinate, or their mixture, to alkali taurinate.

It is, therefore, an object of the present invention to disclose a process for the production of taurine from alkali isethionate in a high overall yield (i.e., greater than 90% to nearly quantitative). According to the process of the present invention, a solution of alkali ditaurinate or alkali tritaurinate, or their mixture, is mixed with alkali isethionate to increase the yield of the ammonolysis reaction by inhibiting the formation of alkali ditaurinate and tritaurinate byproducts and by converting the byproducts to alkali taurinate in the presence of one or more catalysts.

DESCRIPTION OF THE INVENTION

The present invention relates to a process for the production of taurine by the ammonolysis reaction of alkali isethionate in the presence of alkali ditaurinate or alkali tritaurinate, or their mixture, to inhibit the formation of byproducts, to increase the production yield, and to greatly reduce the waste discharge from the production process.

The process according to the present invention starts with mixing a solution of alkali ditaurinate or alkali tritaurinate, or their mixture, with alkali isethionate, followed by addition of an excess of ammonia. The ammonolysis is carried out at a temperature from 160° C. to 260° C. under the pressure from autogenous to 260 bars for 1 to 6 hours.

After the ammonolysis reaction, excess ammonia is dispelled from the reaction solution and reclaimed for reuse. A solution of alkali taurinate is obtained, along with alkali ditaurinate, alkali tritaurinate, and a trace amount of unreacted alkali isethionate.

The strongly basic solution is neutralized with an acid to pH 5-9 to yield a crystalline suspension of taurine in a solution of alkali salt, alkali ditaurinate, alkali tritaurinate, and a small amount of unreacted alkali isethionate. The initial suspension is optionally concentrated, then cooled to